

REMARKS**Status of Claims:**

Claims 1-14 and 30-56, including independent claims 1, 30, and 44, have been rejected under 35 USC 103. Rejection of each independent claim is discussed in these remarks.

A. Claim Rejection 35 US 103, Claim 1 and Dependents

Independent claim 1 and its dependent claims 1-12 and 14 have been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 6,258,696, in view of Lyons et al., US Patent No. 5,930,645.

The Examiner says of Lyons et al.:

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the semiconductor region (402') of Lee over a semiconductor substrate as taught by Lyons because the impurity concentration of the semiconductor regions (device layer) can easily be controlled and crystalline perfection can be achieved. This matter is well known in the art.

MPEP 2143 describes the basic requirements of a *prima facie* case of obviousness:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.

As no suggestion in the prior art to modify the reference is identified by the Examiner, Applicants respectfully submit that a *prima facie* case of obviousness has not

been established. This lack of a suggestion to combine is found in the 103(a) rejections of independent claims 30 and 44, as well.

In addition, Applicants respectfully traverse these rejections because Lee et al. and Lyons et al. fail to disclose each and every element recited in independent claim 1.

Relative area and width of regions not taught in references

Claim 1 recites a wafer having a surface, the wafer comprising a plurality of regions of semiconductor and dielectric exposed at the surface of the wafer after chemical mechanical planarization, the semiconductor regions formed over a substrate, wherein the semiconductor regions have a total surface area that is less than or equal to a first fraction of a total surface area of the wafer and each of the semiconductor regions have a shortest surface dimension that is less than or equal to a first width, the first fraction and the first width ensuring that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom.

Lee et al. apparently teach alternating lines of semiconductor substrate 402' and insulation film 403 planarized by CMP or an etch-back process (column 4, lines 50-59.) But the reference fails to recognize the difficulty of cleaning such a surface following CMP. It gives no guidance regarding the relative widths of the lines of semiconductor substrate 402' and the lines of insulation film 403, and nowhere suggests or teaches that the semiconductor region fraction of the wafer surface, or the width of any semiconductor region, must be selected to ensure that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom.

'To assume the relative widths of the lines of semiconductor substrate 402' and the lines of insulation film 403 from a subjective estimate of their appearance in figures, in the absence of an explicit teaching, is improper. Referring to MPEP 2125:

When the reference does not disclose that the drawings are to scale and is silent as to dimensions, arguments based on measurement of the drawing features are of little value.

MPEP 2125 continues, quoting from *Hockerson-Halberstadt, Inc. v Avia Group Int'l*, 222 F.3d 951, 956, 55 USPQ2d 1487, 1491 (Fed. Cir. 2000):

"[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue."

Lee et al. are completely silent on the relative widths and relative fraction of semiconductor and dielectric regions on the wafer; thus these cannot properly be inferred from drawings which are not represented to be scale drawings. This reasoning applies to the 103(a) rejections of independent claims 30 and 44 as well.

Product-by-process limitations

The Examiner notes that the expressions "after chemical planarization" and "allowing removal of residual particles therefrom" are "taken to be ... product by process limitation[s] and [are] given no patentable weight." The Examiner further notes "it is the patentability of the final structure of the product 'gleaned' from the process steps, which must be determined in a 'product by process' claim, and not the patentability of the process."

The Examiner is correct that the phrase "after chemical mechanical planarization" describes part of the process used to create the wafer claimed in claim 1. The phrase "allowing removal of residual particles therefrom," however, does not describe part of the

process of creating the wafer, but rather describes a property of the claimed wafer, and thus is entitled to patentable weight.

Recall that the invention relates to wet cleaning of wafer surfaces following chemical mechanical planarization (CMP). An aqueous cleaning technique is conventionally used to remove residual slurry particles from a silicon dioxide dielectric surface following CMP and to remove residual slurry particles from a combined silicon dioxide and silicon nitride dielectric surface following shallow trench isolation (STI) planarization. Both silicon dioxide and silicon nitride are hydrophilic. However, when silicon is exposed following a CMP process, a hydrophobic (i.e., water-repelling) surface is created, which makes it difficult to use aqueous NH₄OH-based scrubbing. The silicon surface does not sufficiently wet to permit the polyvinyl alcohol brushes coming into intimate contact with the wafer surface, and the residual slurry particles and/or metal contaminants are not removed.

An object of the invention, then, is to provide a wafer surface comprising semiconductor and dielectric that attracts enough water to allow the wafer surface to wet so that residual slurry particles and metal contaminants may be removed therefrom. The invention is not a wafer surface that has been cleaned, but rather one that has the characteristic of being wettable, and thus cleanable. Thus the entire phrase, "the first fraction and the first width ensuring that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom" specifies not the process used to make the wafer, but rather a property the wafer, "the product 'gleaned' from the process steps" referred to by the Examiner above, must have. The property

defined by this phrase, therefore, is a crucial limitation to the claim, and must in fact be given patentable weight.

Because the combination of Lee et al. and Lyons et al. fails to teach each and every element recited in independent claim 1, Applicants request that the 35 U.S.C. § 103(a) rejections of independent claim 1 and its dependent claims be withdrawn.

B. Claim Rejection 35 US 103, Claim 30 and Dependents

Independent claim 30 and its dependent claims 35-41 and 43 have been rejected under 35 USC 103(a) as being unpatentable over Lee et al. in view of Lyons et al.

As noted earlier, no suggestion to combine these references was identified by the Examiner, and thus a *prima facie* case of obviousness has not been made. In addition, Applicants respectfully traverse these rejections because Lee et al. and Lyons et al. fail to disclose each and every element recited in independent claim 30.

Claim 30 recites a wafer having a surface, the wafer comprising means for attracting water to the surface of the wafer; and means for repelling water from the surface of the wafer comprising regions above a substrate that have a combined surface area that is less than or equal to a first fraction of a surface area of the wafer, wherein each of the regions has a shortest surface dimension that is less than or equal to a first width, and the first fraction and the first width ensure that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom.

As noted above, Lee et al. fail to recognize the difficulty of cleaning such a surface following CMP. The reference gives no guidance regarding the relative widths of the lines of means for repelling water (402') and the lines of means for attracting water (403), and nowhere suggests or teaches that the fraction of the wafer surface comprising

means for repelling water from the surface of a wafer, or the width of regions of such means, must be selected to ensure that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom.

Because the combination of Lee et al. and Lyons et al. fail to teach each and every element recited in independent claim 30, Applicants request that the 35 U.S.C. § 103(a) rejections of independent claim 30 and its dependent claims be withdrawn.

C. Claim Rejection 35 US 103, Claim 44 and Dependents

Independent claim 44 and its dependent claims 49-54 and 56 have been rejected under 35 USC 103(a) as being anticipated by Lee et al. in view of Lyons et al. As noted earlier, no suggestion to combine these references was identified by the Examiner, and thus a *prima facie* case of obviousness has not been made. In addition, Applicants respectfully traverse these rejections because the combination of Lee et al. and Lyons et al. fail to disclose each and every element recited in independent claim 1.

Claim 44 recites a wafer having a surface, the wafer comprising a plurality of regions of hydrophobic material and hydrophilic material exposed at the surface of the wafer after chemical mechanical planarization, wherein the regions of hydrophobic material have a total surface area that is less than or equal to a first fraction of a total surface area of the wafer and each of the regions of hydrophobic material have a shortest surface dimension that is less than or equal to a first width, the first fraction and the first width ensuring that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom.

As noted above, Lee fails to recognize the difficulty of cleaning such a surface following CMP. It gives no guidance regarding the relative widths of the lines of

hydrophobic material (402) and the lines of hydrophilic material (403), and nowhere suggests or teaches that the fraction of the wafer surface comprising hydrophobic material, or the width of regions of hydrophobic material, must be selected to ensure that the surface of the wafer can attract enough water to wet sufficiently allowing removal of residual particles therefrom.

Because the combination of Lee et al. and Lyons et al. fail to teach each and every element recited in independent claim 44. Applicants request that the 35 U.S.C. § 103(a) rejections of independent claim 44 and its dependent claims be withdrawn.

IV. Conclusion

In view of these remarks, Applicants submit that this application is in condition for allowance. Reconsideration is respectfully requested. As Applicants and the Examiner have made and reiterated certain points without coming to clear agreement, if objections remain, Applicants believe a discussion of amendments, appeal, or other options would prove fruitful, and respectfully request an interview. In the event that objections remain, the Examiner is asked to contact the undersigned agent at (408) 869-2921.

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Date

Pamela J. Squyres
Agent for Applicants
Reg. No. 52246

Pamela J. Squyres
Matrix Semiconductor
3230 Scott Blvd
Santa Clara, CA 95054
Tel. 408-869-2921

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